

# PASSAGE IMPROVEMENT EVALUATION

8506200

## SHORT DESCRIPTION:

Implement needed fish passage improvements at irrigation dams in the Yakima River Basin. Provide hydrological evaluations of fisheries screening facilities.

**SPONSOR/CONTRACTOR:** Battelle-Northwest  
Battelle, Pacific Northwest National Laboratory  
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## SUB-CONTRACTORS:

N/A There are no sub-contracts planned for the proposed work.

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## GOALS

### GENERAL:

Supports a healthy Columbia basin, Maintains biological diversity, Maintains genetic integrity, Increases run sizes or populations, Provides needed habitat protection

### ANADROMOUS FISH:

Habitat or tributary passage

### NPPC PROGRAM MEASURE:

7.11B.1

### RELATION TO MEASURE:

Bonneville Power Administration will implement needed fish passage improvements at irrigation dams under Council Measure 7.11B.1. This project provides BPA with the fisheries and hydrological evaluations of fisheries screening facilities to ensure that the screens meet the objectives stated in 7.11B.1.

### TARGET STOCK

Steelhead

Coho

Fall chinook

Spring chinook

### LIFE STAGE

Juvenile

Juvenile

Juvenile

Juvenile

### MGMT CODE (see below)

### AFFECTED STOCK

Resident Fish

### BENEFIT OR DETRIMENT

Beneficial

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## BACKGROUND

### STREAM AREA AFFECTED

#### Stream name:

Yakima River and tributaries

#### Subbasin:

Yakima

#### Stream miles affected:

1900

#### Land ownership:

Both

#### Hydro project mitigated:

The Yakima Basin is an off-site mitigation subbasin.

### HISTORY:

Project 8506200 began in 1985 with a fisheries evaluation the Sunnyside Canal Fish Screening Facility. Since 1985, project staff have completed fisheries evaluations at: Richland Canal Fish Screening Facility, Toppenish/Satus Canal Fish Screening Facility, Wapato Canal Fish Screening Facility, Toppenish Creek Canal Fish Screening Facility, Westside Ditch Fish Screening Facility, and Town Canal Fish Screening Facility. Water velocity evaluations were also completed at the Columbia Canal Fish Screening Facility, Roza Canal Fish Screening Facility, Easton Canal Fish Screening Facility, and Chandler Canal Fish Screening Facility. Project staff evaluated the potential for migration delay and increased loss to predation at Wapato and Sunnyside Canal Fish

Screening Facilities during 1991 operations. They evaluated the Dryden Fish Screening Facility during 1994. In addition, components of modular fish screens were evaluated in the laboratory at Richland during 1994 and 1995.

### **BIOLOGICAL RESULTS ACHIEVED:**

Project staff have conducted fisheries and hydrological evaluations at about 30 fish screening facilities in Washington and Idaho. Additionally, they have conducted laboratory experiments with low volume modular screening facilities. Using the combined results of the evaluations, the project staff have concluded that:

1. Fish are safely returned from irrigation canals back to the river or stream from which they were diverted when fish screening facilities are properly designed, constructed, and maintained.
2. Fish 40 mm in length or larger can be prevented from passing through fish screening facilities when current screening design, construction, and maintenance criteria are followed.
3. Predation rates at fish screening facilities are probably the same as predation rates in the river or stream from which they were diverted, assuming the screen design, construction and maintenance meet current criteria.
4. Migration rates or movement behavior for fish at fish screening facilities are probably the same as those for fish in the river or stream from which they were diverted, assuming the screen design, construction and maintenance meet current criteria
5. Fish screening effectiveness is highly dependent on proper operation and timely maintenance of all components of the fish screen facility.

Fish that are diverted from a river or stream into an irrigation diversion are potentially subjected to conditions that can directly or indirectly impact migration. Fish screening facilities have been installed in irrigation ditches to prevent fish from being diverted into irrigation ditches and to safely return fish to the stream or river from which they have been diverted. Criteria to protect fish screening facilities have been evolving since fish screens were first designed and constructed in the Pacific Northwest. During the 1980s, it became apparent that many diversions were unscreened and many existing screens did not meet the criteria needed to adequately protect fish.

Project staff, beginning with the evaluation of the Sunnyside Canal Fish Screening Facility, examined newly constructed screens to ensure that fish were being protected. Five criteria were established to determine if screens were adequately protecting fish.

They are:

1. Fish are not killed or injured as they are diverted from the irrigation canal back to the river.
2. Fish can not pass downstream of the facility into the irrigation canal
3. Migrating fish are not delayed in or by the fish screening facility.
4. Fish are not subjected to increased predation by the presence or operation of the screening facility.
5. Fish are protected during all possible screen operating scenarios, including periods between scheduled maintenance.

The region has excellent criteria for protecting most fish at irrigation diversions. The challenges for the future include: providing complete protection for fish less than 40 mm in length, reduction of operation and maintenance expenses without sacrificing benefit to fish, and development and implementation of a monitoring program to ensure that operating facilities continue to meet design criteria.

### **PROJECT REPORTS AND PAPERS:**

Neitzel, D.A., T.C. Carlson, R.L. Mueller, and W.V. Mavros. In press. Evaluation of Infrasound for Enhancing the Capacity of Fish Screening Facilities to Protect Outmigrating Salmonids. Prepared for the Bonneville Power Administration by the Pacific Northwest Laboratory, Richland, Washington

Neitzel, D.A., C.S. Abernethy, S.L. Blanton, and R.P. Mueller. 1996. "Movement of Fall Chinook Salmon Fry *Oncorhynchus tshawytscha*: A Comparison of Approach Angles for Fish Bypass in a Modular Rotary Drum Fish Screen." Prepared for the Bonneville Power Administration by the Pacific Northwest Laboratory, Richland, Washington

Mueller, R.P., C.S. Abernethy, and D.A. Neitzel. 1995. A Fisheries Evaluation of the Dryden Fish Screening Facility. Prepared for the Bonneville Power Administration by the Pacific Northwest Laboratory, Richland, Washington

Abernethy, C.S., and D.A. Neitzel. 1995. Movement and Injury Rates for Three Life Stages Of Spring Chinook Salmon *Oncorhynchus tshawytscha*: A Comparison of Submerged Orifices and an Overflow Weir for Fish Bypass in a Modular Rotary Drum Fish Screen. Prepared for the Bonneville Power Administration by the Pacific Northwest Laboratory, Richland, Washington

Abernethy, C. S., D. A. Neitzel, and E. W. Lusty. 1990. Velocity Measurements at Three Fish Screening Facilities in the Yakima River Basin. Prepared for the Bonneville Power Administration by the Pacific Northwest Laboratory, Richland, Washington.

Neitzel, D. A., C. S. Abernethy, and E. W. Lusty. 1990. A Fisheries Evaluation of the Wapato, Sunnyside, and Toppenish Creek Canal Fish Screening Facilities, Spring 1988. Prepared for the Bonneville Power Administration by the Pacific Northwest Laboratory, Richland, Washington.

Neitzel, D. A., C. S. Abernethy, and E. W. Lusty. 1990. A Fisheries Evaluation of the Westside Ditch and Wapato Canal Fish

Screening Facilities, Spring 1989. Prepared for the Bonneville Power Administration by the Pacific Northwest Laboratory, Richland, Washington.

Neitzel, D. A., C. S. Abernethy, and G. A. Martenson. 1990. A Fisheries Evaluation of the Westside Ditch and Town Canal Fish Screening Facilities, Spring 1990. Prepared for the Bonneville Power Administration by the Pacific Northwest Laboratory, Richland, Washington.

Abernethy, C. S., D. A. Neitzel, and E. W. Lusty. 1989. Velocity Measurements at Six Fish Screening Facilities in the Yakima River Basin. Prepared for the Bonneville Power Administration by the Pacific Northwest Laboratory, Richland, Washington.

Neitzel, D. A., C. S. Abernethy, E. W. Lusty, and S. J. Wampler. 1988. A Fisheries Evaluation of the Richland and Wapato Canal Fish Screening Facility, Spring 1987. Prepared for the Bonneville Power Administration by the Pacific Northwest Laboratory, Richland, Washington.

Neitzel, D. A., C. S. Abernethy, and E. W. Lusty. 1986. A Fisheries Evaluation of the Richland and Toppenish/Satus Canal Fish Screening Facility, Spring 1986. Prepared for the Bonneville Power Administration by the Pacific Northwest Laboratory, Richland, Washington.

Neitzel, D. A., C. S. Abernethy, E. W. Lusty, and L. A. Prohammer. 1985. A Fisheries Evaluation of the Sunnyside Canal Fish Screening Facility, Spring 1985. Prepared for the Bonneville Power Administration by the Pacific Northwest Laboratory, Richland, Washington.

Neitzel, D. A., D. A. New, C. S. Abernethy, and C. Keller. 1994. Monitoring and Evaluation of the Fish Screening Facilities in the Lemhi River Basin of Idaho, United States. Presented at the 1994 American Fisheries Society Annual Meeting, Halifax, Nova Scotia.

Hoffmann, A. C. S. Abernethy, and D. A. Neitzel. 1994. Survival Estimates for Spring and Fall Chinook Salmon, and Coho Salmon Smolts in the Yakima River. Presented at the 1994 American Fisheries Society Annual Meeting, Halifax, Nova Scotia.

Abernethy, C. S., and D. A. Neitzel. 1991. "A Summary of Fisheries Evaluations of Rotary Drum Fish Screening Facilities in the Yakima Basin, 1985-1990." Presented at the Pacific Fishery Biologists 53rd Annual Meeting, Sun River, Oregon.

Neitzel, D. A., C. S. Abernethy, and E. W. Lusty. 1991. "Evaluation of Rotating Drum Screen Facilities in the Yakima River Basin, South-Central Washington State." Fisheries Bioengineering Symposium, American Fisheries Society Symposium 10:325-334.

Neitzel, D. A., T. J. Clune, and C. S. Scott. 1990. "Evaluation of Rotary Drum Screens Used to Protect Juvenile Salmonids in the Yakima River Basin, Washington, USA" Presented on October 18-22, 1990, Gifu, Japan.

Neitzel, D. A. 1989. "Assessment of Irrigation Screen Facilities Effects on Juvenile Salmonids in the Yakima River, Washington." Presented at the Annual Meeting of the American Fisheries Society, September 4-8, 1989, Anchorage, Alaska.

Neitzel, D. A., C. S. Abernethy, and E. W. Lusty. 1988. "Evaluation of Fish Screening Facilities in the Yakima Basin, Washington." Program for Fisheries Bioengineering Symposium, American Fisheries Society: Bioengineering Section, October 24-27, 1988, Portland, Oregon.

#### **ADAPTIVE MANAGEMENT IMPLICATIONS:**

Unscreened and inadequately screened irrigation diversions, or poorly maintained screens facilities result in the loss of many juvenile salmon and steelhead that have survived the rigors of natural rearing only to be killed at the beginning of their journey to the ocean. Screening irrigation diversions has a high probability of reducing salmon and steelhead mortality and will require the use of all available resources for funding, design, construction and installation.

Project 8506200 has provided the region with the evaluations of installed screening facilities to ensure that the facilities are accomplishing the objectives for which they were designed and built. Monitoring of the screening facilities' compliance with the design and maintenance criteria is key to measure 7.11B of meeting its objective of protecting juvenile salmon and steelhead during their migration to the ocean.

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## **PURPOSE AND METHODS**

#### **SPECIFIC MEASUREABLE OBJECTIVES:**

1. Provide fisheries and hydrological evaluations of new screens as they are installed.
2. Provide a laboratory facility for testing proposed changes to facility components (e.g., new bottom seals, forebay configurations, screen mesh size).
3. Provide on site monitoring of operating screens.

All these tasks are coordinated with BPA technical staff and address current and projected needs of the staff at the Washington State Department of Fish and Wildlife, U.S. Bureau of Reclamation, Yakima Indian Nation, and National Marine Fisheries Service.

## CRITICAL UNCERTAINTIES:

Uncertainties underlie the assumptions for testing the hypothesis that fish screening facilities can be designed, constructed, operated and maintained to protect fish that are diverted into irrigation canals. The critical uncertainties are:

1. Can fish be killed or injured as they are diverted from the irrigation canal back to the river?
2. Can fish pass downstream of the facility into the irrigation canal?
3. Are migrating fish delayed in or by the fish screening facility?
4. Are fish subjected to increased predation by the presence or operation of the screening facility?
5. Are fish protected during all possible screen operating scenarios, including periods between scheduled maintenance?

## BIOLOGICAL NEED:

During the last 50 years, state and federal entities have initiated water screening diversion programs throughout the Columbia River basin. Hundreds of screens have been installed at withdrawals from important fish producing streams. Unfortunately, salmon and steelhead are still being lost in diversions throughout the basin. A large number of diversions remain unscreened. The region, through the cooperation of the state fisheries agencies and the National Marine Fisheries Service, has developed and maintained design, construction, operational, and maintenance criteria to provide fish screening facilities that protect fish. Screens are placed in a harsh environment. Water quality changes erode the metal components of the screen facilities. Ice and large debris block and stress screen structures. Sediments change flow patterns at the screen facilities. The need to evaluate screens after they are constructed and after they have been in operation needs to continue to ensure that the criteria are being met and that fish are being protected.

Additionally, new challenges continue to appear as new screens are put into operation. In recent years, we have demonstrated that fish that are less than 40 mm in length are not always protected by the current design and operational criteria. New screen mesh sizes need to be tested. New technologies, e.g., infrasound need to be tested for application at screen facilities.

Initiate technical assistance task by contacting approved agencies to identify their current needs - Initiate during January 1996

Evaluation of infrasound system in modular screen system - February through June 1996

Evaluation of forebay configurations for 6-foot screen - February through June 1996

Field Survey #1 of up to 20 Phase II sites - during June and July 1996

Update evaluation of previously evaluated sites - during June, July and August 1996

Field Survey #2 of up to 20 Phase II sites - August 1996

Field Survey #3 of up to 20 Phase II sites - September and October 1996

Presentation of field survey results and pertinent assistance tasks at screen fabrication workshop - March 1996

## METHODS:

The methods used to meet the objectives for Project 8506200 are:

1. Conduct fisheries and hydrological evaluations of the newly installed fish screening facilities.
2. Conduct fisheries and hydrological evaluations at established fish screening facilities to monitor operational changes and maintenance effectiveness.
3. Establish and maintain fish screening facilities at the Pacific Northwest National Laboratory in Richland, Washington to provide a controlled setting for testing design and operational changes to screen facilities.

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## PLANNED ACTIVITIES

### SCHEDULE:

<u>Planning Phase</u>	<u>Start</u> 3/97	<u>End</u> 6/97	<u>Subcontractor</u>
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<u>Task</u> Placement of all pre-1997 screen evaluation reports on website			
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<u>Planning Phase</u>	<u>Start</u> 10/97	<u>End</u> 11/97	<u>Subcontractor</u>
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<u>Task</u> Engineering analysis for applying sound to irrigation facilities			
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<u>Planning Phase</u>	<u>Start</u> 7/97	<u>End</u> 9/97	<u>Subcontractor</u>
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<u>Task</u> Determine standards for achieving the performance required to meet biological, operational, and cost effectiveness with infrasound behavioral barrier at irrigation screens			
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<u>Planning Phase</u>	<u>Start</u> 4/97	<u>End</u> 6/97	<u>Subcontractor</u>
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<u>Task</u> Design infrasound test to be conducted at an irrigation facility			
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<b><u>Planning Phase</u></b>	<b><u>Start</u></b> 2/97	<b><u>End</u></b> 7/97	<b><u>Subcontractor</u></b>
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**Task** Conduct Laboratory Tests with 35mm length fish;  
Examine habituation of startle response for zero-age salmonids;  
Examine other sound sources than tested during 1996;  
Identify sound source and metrics that could be used at an irrigation.

<b><u>Planning Phase</u></b>	<b><u>Start</u></b> 12/97	<b><u>End</u></b>	<b><u>Subcontractor</u></b>
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**Task** Complete Placement of 1997 reports on electronic network

<b><u>Planning Phase</u></b>	<b><u>Start</u></b> 10/97	<b><u>End</u></b>	<b><u>Subcontractor</u></b>
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**Task** Draft Report of field survey evaluations

<b><u>Planning Phase</u></b>	<b><u>Start</u></b> 9/97	<b><u>End</u></b>	<b><u>Subcontractor</u></b>
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**Task** Field Survey #2 of up to 20 Phase III sites

<b><u>Planning Phase</u></b>	<b><u>Start</u></b> 7/97	<b><u>End</u></b>	<b><u>Subcontractor</u></b>
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**Task** Field Survey #2 of up to 20 Phase II sites

<b><u>Planning Phase</u></b>	<b><u>Start</u></b> 6/97	<b><u>End</u></b> 8/97	<b><u>Subcontractor</u></b>
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**Task** Re-visit Phase I sites

<b><u>Planning Phase</u></b>	<b><u>Start</u></b> Monthly	<b><u>End</u></b>	<b><u>Subcontractor</u></b>
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**Task** Letter report of technical assistance tasks

<b><u>Planning Phase</u></b>	<b><u>Start</u></b> As needed, begin 4/97	<b><u>End</u></b>	<b><u>Subcontractor</u></b>
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**Task** Begin evaluation of identified design or operational concerns using modular fish screen at the PNNL laboratory.

<b><u>Planning Phase</u></b>	<b><u>Start</u></b> 4/97	<b><u>End</u></b>	<b><u>Subcontractor</u></b>
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**Task** Field survey #1 of up to 20 Phase II sites; Purchase sound source and metrics that could be used at an irrigation; Conduct consultations with BPA and Fish Screening Oversight Committee; Linking of PNNL and BPA sites for screen information

<b><u>Planning Phase</u></b>	<b><u>Start</u></b> 3/97 or as scheduled	<b><u>End</u></b>	<b><u>Subcontractor</u></b>
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**Task** Preparation of field survey results and pertinent technical assistance tasks at screen fabrication workshop; Demonstration of website at 1997 screen workshop

<b><u>Planning Phase</u></b>	<b><u>Start</u></b> 2/97	<b><u>End</u></b>	<b><u>Subcontractor</u></b>
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**Task** Initiate technical assistance task by contacting approved agencies to identify their needs.

## **CONSTRAINTS OR FACTORS THAT MAY CAUSE SCHEDULE OR BUDGET CHANGES:**

The risks associated with project 8506200 are inherit in the underlying assumptions:

1. Fish are not killed or injured as they are diverted from the irrigation canal back to the river.
2. Fish can not pass downstream of the facility into the irrigation canal
3. Migrating fish are not delayed in or by the fish screening facility.
4. Fish are not subjected to increased predation by the presence or operation of the screening facility.
5. Fish are protected during all possible screen operating scenarios, including periods between scheduled maintenance.

If any of these assumptions about the screens that are being designed, constructed, operated, and maintained in the Columbia River basin are false, salmon and steelhead will not be protected. Project 8506200 objectives are to determine that fish are being protected at irrigation diversions.

## **OUTCOMES, MONITORING AND EVALUATION**

### **SUMMARY OF EXPECTED OUTCOMES**

#### **Expected performance of target population or quality change in land area affected:**

The state and federal entities that are designing, constructing, operating and maintaining fish screening facilities throughout the b

asin need to know which screens are meeting the criteria for protecting salmon and steelhead. The evaluations will provide information to answer questions about:

1. injury and mortality rates at existing screens,
2. passage failures for screens, screen seals, and operational procedures,
3. possibility of migration delays,
4. incidence of increased predation at screen facilities
5. operational changes that might adversely affect fish at screening facilities,
6. the potential for application of new technologies at screen facilities, and
7. adequacy of maintenance procedures at screens.

#### **Information products:**

An evaluation of the screening facilities in the Yakima Basin.

#### **MONITORING APPROACH**

The methods used to meet the objectives for Project 8506200 are:

1. Conduct fisheries and hydrological evaluations of the newly installed fish screening facilities.
2. Conduct fisheries and hydrological evaluations at established fish screening facilities to monitoring operational changes and maintenance effectiveness.
3. Establish and maintain fish screening facilities at the Pacific Northwest National Laboratory in Richland, Washington to provide at controlled setting for testing design and operational changes to screen facilities.

#### **Information feed back to management decisions:**

The data will be provided to state and federal agencies that are designing and constructing fish screening facilities.

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### **RELATIONSHIPS**

#### **RELATED BPA PROJECT**

Various

#### **RELATIONSHIP**

(See text in Opportunities for Cooperation section below)

#### **OPPORTUNITIES FOR COOPERATION:**

Project staff regularly work with Washington State Department of Fish and Wildlife, the Idaho Fish and Game, the U.S. Bureau of Reclamation, and the National Marine Fisheries Service. Project work also requires coordination with the irrigation districts of the Yakima Basin and the Yakama Indian Nation.

Project 8506200 is related to screen improvement projects throughout the basin. These include: 7.10A.3 (Fisheries Managers maintenance of a prioritized list of tributary screening and passage facilities), 7.10A.4 (National Marine Fisheries Service, Working Oversight Committee, Appropriate Technical Work Groups and Bonneville identification of resources needed to accomplish screening and passage and monitoring and evaluation plans), 7.10A.5 (Bureau of Land Management, Idaho and Oregon/Washington Offices; U.S. Forest Service Regions 1,4,6; and Bureau of Reclamation, Pacific Northwest Region requirements that existing and new water use authorizations have functional fish screens and other passage facilities), 7.10A.6 (Corps of Engineers inspection of underwater diversions), 7.10A.7 (Idaho, Oregon, Washington requirements that installation, operation, and maintenance of fish screens are in compliance with state laws), 7.10.D (Bonneville's evaluation of Dryden Dam screens), and 7.11 (Improvement of irrigation diversions in the Yakima River basin).

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### **COSTS AND FTE**

**1997 Planned:** \$120,000

#### **FUTURE FUNDING NEEDS:**

#### **PAST OBLIGATIONS (incl. 1997 if done):**

<u>FY</u>	<u>\$ NEED</u>	<u>% PLAN</u>	<u>% IMPLEMENT</u>	<u>% O AND M</u>	<u>FY</u>	<u>OBLIGATED</u>
1998	\$300,000		0%	100%	1985	\$100,000
1999	\$300,000		0%	100%	1986	\$200,000
2000	\$300,000		0%	100%	1987	\$200,000

1988	\$200,000
1989	\$300,000
1990	\$150,000
1991	\$720,000
1992	\$733,000
1993	\$976,650
1994	\$883,000
1995	\$390,600
1997	\$120,000

TOTAL: \$4,973,250

Note: Data are past obligations, or amounts committed by year, not amounts billed. Does not include data for related projects.

**1997 OVERHEAD PERCENT:** 68%

**HOW DOES PERCENTAGE APPLY TO DIRECT COSTS:**

This applies to the Direct Labor plus Indirect Labor costs and the General and Administrative Costs.

**CONTRACTOR FTE:** 5 (none of these staff are employed full time on this work.)

**SUBCONTRACTOR FTE:** N/A No subcontracting is planned.